

## ABSTRACT OF THE DISCLOSURE

Oxygen is doped in a quantum well active layer. First, an n-type  $\text{In}_{0.02}\text{Ga}_{0.98}\text{N}$  barrier layer 550 of 10 nm is formed by supplying TMG at 10sccm, TMI at 30sccm,  $\text{O}_2$  at 20 sccm, and  $\text{NH}_3$  at 10 slm, on the n-type GaN optical guide layer 405. Next, a molar flow rate of TMI is increased to 50sccm, and an undoped  $\text{In}_{0.2}\text{Ga}_{0.8}\text{N}$  well layer 553 of 3 nm is formed. This process is repeated three cycles, and finally, the process is completed with the n-type  $\text{In}_{0.02}\text{Ga}_{0.98}\text{N}$  barrier layer 550. A p-type  $\text{Al}_{0.2}\text{Ga}_{0.8}\text{N}$  cap layer 407 whose thickness is 20 nm is formed by supplying TMG at 15 sccm, TMA at 5 sccm, and  $(\text{EtCp})_2\text{Mg}$  at 5 sccm and  $\text{NH}_3$  at 10 slm, on a multi-quantum well structure active layer 420 formed in this way.